# REGIONAL ENVIRONMENTAL NOISE INDICATORS: SWOT ANALYSIS AND FUTURE DEVELOPMENTS

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## ABSTRACT

The regional government of the Flemish region is responsible for the environmental legislation within Belgium and reports the impact of environmental burdens since 2003 to support environmental policy. The Ghent university is providing and structuring the indicators for the noise discipline since that time. The underlying data and the quality of the models has evolved through time but in general, the time series of the indicators are very stable. In an-ongoing project, the sensitivity and spatial resolution of the indicators is evaluated and improvements are proposed to achieve even better policy support. In this manuscript, the results of this evaluation will be presented.

The focus is on defining indicators with a region-wide coverage and sensitive to the potential effects of the legislation affecting all types of noise exposure. The goals of the project are manifold: (1) SWOT-analysis identifies strengths, weaknesses, opportunities and threats; (2) potential developments in available data are identified to improve sensitivity; (3) technological options are identified to move from simulated to measured indicators; (4) modifications of the existing indicators are proposed when relevant. The technological developments on low-cost noise monitoring have a huge potential. The large-scale implementation of measurement based indicators for regional and local policy support is under evaluation. Actual implementation will require the alignment of priorities and budgets across different governmental departments.

## 1. INTRODUCTION

Environmental reporting in Flanders (MIRA-VMM) is centralized in an environmental department since 2001 and provides yearly updates on the state of the environment for all disciplines [1]. The noise component is supported by the Ghent University from the start.
Until 2015, the environmental goals were defined in the so-called MINA-plans in five year windows ('MIlieu en NAtuur', Environment and Nature)[2]. This approach was not renewed at the end of the last plan. A new approach is defined on governmental level in 2019. After nearly twenty years of small adjustments to the individual indicators and a recent major shift on future goal definitions for the noise component by the Flemish Government, it became clear that the entire indicator set had to be evaluated.
For the noise component a major shift is introduced: the goals set as absolute threshold shift towards an unquantified and generalized concept of *'improving the noise climate'* in general. In addition, the implementation of the Environmental Noise Directive generated an overlap between the indicators in the MIRA reports and the communication to the EU. This ongoing project evaluates the current indicators and proposes a new set of indicators matching the new governmental requirements. The project is divided in several steps.

### 1.1 SWOT analysis

For each of the existing indicators a SWOT analysis is performed to identify the strengths, weaknesses, opportunities and threats. In the same process the indicator itself was mapped to the OECD recommendations for qualitative indicators [3].

### 1.2 Brainstorm session with government and source specific stakeholders

Representatives of the data providers and governmental applications of the MIRA indicators gathered in a meeting to discuss the SWOT analysis, to provide up-to-date information on available data and to suggest potential adjustments to the current indicator set.
This meeting illustrated a few differences in approach from third party contributors and governmental users of the indicators. In general, the third party stakeholders didn't support major extension on the current set of indicators while the governmental user did support extension. The governmental requests involved more health impact related outcomes. The health department put the focus on a sleep disturbance indicator.

### 1.3 Potential improvements

The results of the SWOT-analysis and brainstorm session are summarized in a long-list of potential adjusted or new indicators. This long-list is evaluated with a smaller committee to reduce this proposed set of indicators to a short-list of indicators. The short-list is evaluated in detail and when possible the proposed indicators are tested using available data and knowledge.
In this evaluation step, the disentanglement of the END threshold based approached from the current MIRA noise indicators and the shift to the generalized concept of 'improving the noise climate' accumulated in an entirely new frame-work of indicators which is presented in the next section.

### 1.4 Implementation schedule

The evaluation project is ongoing. In the last phase a set of implementation trajectories are proposed to the government.

## 2. THE NEW INDICTAOR ECO-SYSTEM

In Figure 1, the relations between the different components is visualized. The END indicators are presented in orange. This part of the indicator process is organized at the top level of the Flemish Government, independent from the MIRA environmental reporting from the Flemish Environment Agency. The MIRA noise indicators are presented in green. The input data is presented in blue. The same data sources feed both the END and the MIRA noise indicators. Disentangling the END and MIRA indicators based on three main features:

(1) The END indicators provide no full spatial coverage of the Flemish region. The MIRA indicators focus on full geographical coverage of the noise exposure.
(2) The END indicators focus on the higher exposure (> 55 dBA) and the related action plans are designed to reduce the number of high exposed inhabitants. The MIRA indicators will focus on pressure and livability indicators matching the regional environmental goals.
(3) Annoyance is based on internationally standardized annoyance response relations. In Flanders a repeated annoyance survey is available. Including the potential temporal trend in these surveys of reported annoyance and sleep disturbance into the livability indicators will accommodate the wishes of the health department of the Flemish government.

Three types of MIRA indicators will be discussed in the new sections. Pressure indicators should identify the actual improvement of the fleets of the main transportation modes. Exposure indicators are mainly intermediate components to support the livability indicators. The potential application of a citizen science based population exposure indicator is included in the evaluation process. The transition from standardized annoyance assessments to full geographic coverage for modeled reported annoyance is covered in the MIRA statistical models.

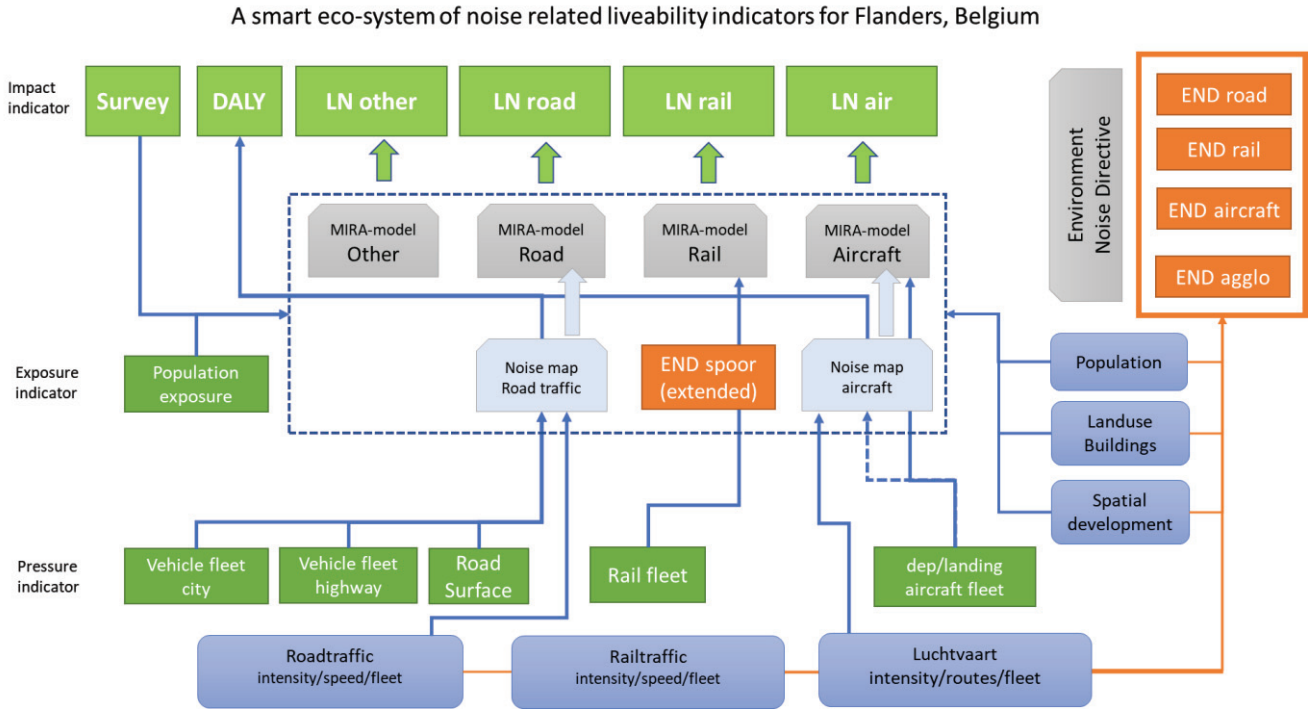


**Figure 1**. The new indicator eco-system.

## 3. PRESSURE INDICATORS

### 3.1 Road traffic

The noise emission module of CNOSSOS does not provide direct evaluations of the changes of the vehicle fleet emissions. The pressure indicators for road traffic aim at quantifying real-life changes in the noise emission of the fleet. Since air pollution based Low Emission Zones (LEZ) also affect the local vehicle fleet, two pressure indicators are proposed: the fleet in the context of a city and the fleet on highways and major roads. Road surface is the other main component in the local variation in noise emission. Improvements of the external data include the potential implementation of the measurement based approach presented in earlier work [4].

### 3.2 Rail traffic

The TSI guideline and the extension through 'Quieter routes' will improve the fleet emission of the rail freight. The TSI is an ongoing effort while 2024 is a reference date for the 'Quieter routes' implementation. This indicator aims at quantifying the impact of this legislation on real-life emissions in Flanders and Belgium.

### 3.3 Aircraft fleet

The European Union Aviation Safety Agency (EASA) expects a small reduction of the noise emission per aircraft [6]. The most recent noise limits - Chapter 14 – is applicable since 2018. The average age of the commercial

fleet is 11 years. The implementation of Chapter 14 in will start to take effect in the following years. A measurement based indicator will assess the aircraft fleet at departure and landing for the three main airports in Flanders.

## 4. EXPOSURE INDICATORS

### 4.1 Regional noise map for road traffic

The current regional noise map will be enhanced. The potential improvements include real-life speed of the vehicle flow in the noise emission model, improved road surface quality, integration of the MIRA pressure indicators and screening. This improved version of the map will provide the data required in the matching MIRA model.

### 4.2 Regional noise map for rail traffic

The current END noise map for railway traffic is close to a full geographical coverage in Flanders. The Flemish government investigates a small extension in the tender on the current END trajectory by including all railways and calculate the exposure down to $L_{den}$ 45 dBA instead of the $L_{den}$ 55required for the END. This extended noise map will provide the data required in the matching MIRA model.

### 4.3 Regional noise map for aircraft

The noise survey in Flanders reports 2.2% of the population to be highly annoyed by aircraft noise. Only 0.17% of the reported annoyance occurs within the END-based $L_{den}$ 55 contour maps. A region-wide aircraft noise map will be established using open source data of flight movements. This map will both supply $L_{Aeq}$ as number of events for the entire region. This innovative map will provide the data required in the matching MIRA model.

### 4.4 Citizen Science based population exposure

Questions for noise monitoring at dwelling within the emerging citizen science projects are going through the roof. It proves the relevance of noise as an environmental stressor. This momentum can be used to collect noise measurement at large scale. Selecting the best approach to retrieve a long-term MIRA indicator is subject for further research.

## 5. LIVEABILITY INDICATORS

The MIRA models are land-use based statistical models combining the reported annoyance in the Flemish noise surveys with the relevant spatial information of which the corresponding noise map is only one component. The pressure indicators will be integrated as long-term trends in the noise emission components.

An example of the approach is available in earlier work [7]. These models will be built for road traffic noise, railway noise and aircraft noise. The approach will be tested for industrial noise, recreation and neighborhood noise.

The model will predict the annoyance and sleep disturbance response in each dwelling in Flanders. Therefor we propose a new and positive metric: *"Number of inhabitants with a good quality noise environment for the selected noise source"*.

The exposure layers and indicator can be updated on yearly basis. The Flemish noise survey is repeated every four or five years. This combination will improve the understanding of the long-term trends in reported responses and maps directly to the new goals of the Flemish government to improve quality of the environment, in contrast with the END approach of reducing the number of most exposed inhabitants.

## 6. CONCLUSIONS

This evaluation of the noise indicator for the Flemish region is an ongoing process with the aim to provide high quality and sensitive indicators for the entire region. Significant investments will be necessary to achieve the goals but it will provide a state-of-the-art policy support tool, replacing the -now outdated but at the time of implementation- progressive MINA-plan approach of the early 2000's. The proposal will merge and align different policy trajectories on the burden of noise in the Flemish government. The focus shifts from avoiding exposure hotspots towards a quality of the living environment indicator for each noise burden.

## 7. REFERENCES


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